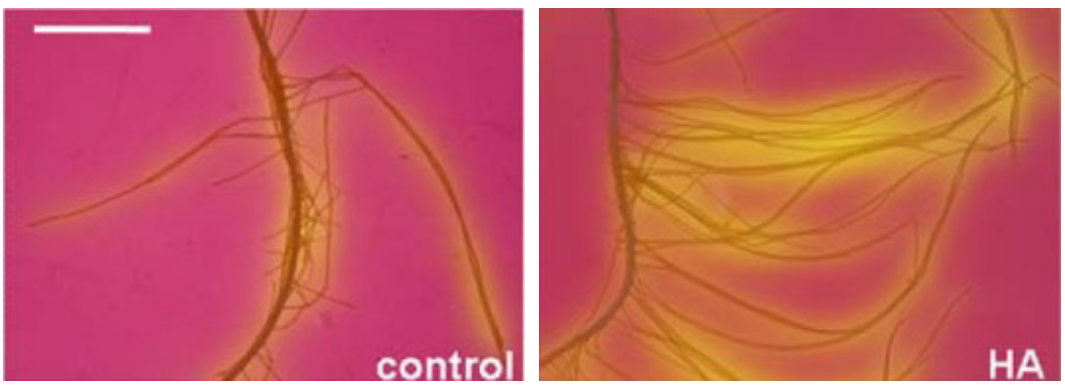
Increase Nutrient Use Efficiency with Humic Acids

We all know organic matter (OM) is good for crops. In most cases, the more organic matter content in the soil, the better. What fewer people realize is that organic matter degrades over time into humic and fulvic acids (HA and FA). The process takes years, but these substances are agronomically important to plant health. Plants are highly evolved to use soil substances and microorganisms to better use nutrients and mitigate abiotic stressors. However, high cropping intensity and heavy use of inorganic fertilizers in recent decades have depleted OM in the soil — and thus HA, FA, and the diversity of the soil microbiome.

High cropping intensity isn't going away, and neither are high-yielding cultivars. The need to produce more in less space is increasing. Continuing to manage and sustain as much OM as possible within the soil is always a good agronomic practice. But rather than waiting the years necessary for it to turn into HA and FA, applying commercially made products makes sense.



Humic acid increases root growth and acidity in the root zone, improving nutrient absorption. Yellow regions correspond to acidification below pH 6.0. Source: Façanha et al. Planta (2010) 231:1025–1036

In a recent webinar, "Nutrient Use Efficiency (NUE) and the Beneficial Role Humic Acids Play," presented by Borregaard, company experts Daniel Gomez, Technical Plant Application Manager-Plant Nutrition, and Jim Shone, Plant Nutrition Area Business Manager, discussed the importance of HA and FA to crop health and yield, and why the proper formulation of commercial products is vital.

"First, we need to know if the products work, and why they work, which needs to be determined by both lab and field trials," said Gomez. "And we have done both. HA and FA have many beneficial effects on crop health and yield, including improving root morphology, nutrient use efficiency, enhancing soil properties such as water-holding capacity, and increasing populations of beneficial soil microbes."

HA and a plant growth hormone, indole-3-acetic acid (IAA), are necessary for activation of H^+-ATPase, a major enzyme protein of the plant cell's plasma membrane. Activation of this enzyme softens the cell wall, increases root hair initiation and length, and pumps protons from within the root to the rhizosphere (area surrounding the roots), where they acidify the soil and enhance solubility of micronutrients. This activity also creates a negative charge within the cell, attracting positively charged compounds such as potassium, ammonium, and nitrate.

"This is one of the master mechanisms of HA," Gomez says. "Plus, more roots lead to a higher concentration of root exudates that improve soil microbial diversity."

That diversity is important, because many soil microbe populations — including those known to improve NUE and resistance to abiotic stress, are increased with HA/FA. Water-holding capacity improves as well, due to their hydrophilic, or water absorbing ability, which keeps more water in the topsoil available for plants.

Increased NUE in the Field

These effects are all shown repeatedly in the lab. The results are echoed in the field. Field trials conducted over three years by the University of Idaho on potatoes compared two rates of HA (1.5 and 3 gal/ac combined with 10-34-0 fertilizer) with the same fertilizer alone. Yield increased significantly, in all three years an average of +4.9% compared with the control. Plus, tissue testing showed a strong correlation between the yield gain and the percentage of increase in the phosphorus content in the plant.

HA and FA increase NUE in nitrogen, as well. Field trials comparing the same amount of urea alone and with 1% HA showed yield gains of 7.9% in corn. HA significantly reduced ammonia volatilization, and lowered nitrogen leaching and nitrous oxide volatilization.

Solubility is key when mixing humic acids with fertilizers such as 10-34-0. Along with being an effective 20% HA formulation, Borregaard's BorreGRO® HA-1 is completely soluble between the pH range between 2 and 12, avoiding incompatibility and precipitation that clogs nozzles.